parallel 35°. The eastward v is a maximum in the neighborhood of latitude 60°, $\theta = 30°$, but vanishes at the poles. This is exactly contrary to Ferrel's result, which made the velocity v a maximum at the pole, before the assumed modification by friction was applied. Oberbeck makes the westward drift a maximum at the plane of the equator, which is certainly not in conformity with the observations. He also makes the westward velocity increase at the equator from the surface to the upper boundary, and show no sign of a reversal from westward to eastward at a moderate elevation, as is generally believed to be the fact, judging from certain well known motions of the air observed in the Tropics.

The United States Weather Bureau has been conducting a series of nephoscope observations in the West Indies for the past three years, and it is hoped that the discussion of these observations, soon to be undertaken, will give us some definite information on this important point.

The second term v_2 modifies v_1, but the two combined, $v = v_1 + v_2$, sustain the conclusions just mentioned. This feature of Oberbeck's solution is so far from conforming to the observed motions of the atmosphere that it seems to me to be inferior in value to Ferrel's for the Tropics. Ferrel's arch over the Tropics, shown in fig. 14, is probably a fact, and if this is so, then the only serious modification required in Ferrel's treatment is to show how the excessive eastward drift in the mid-latitude and polar zones can be effectively checked. It is evident that there must be a large amount of energy available for use in the construction of local cyclones and anticyclones, and that there is, therefore, no pressing need to refer the energy of these motions to any local supply of heat, as is done by those who extend to cyclones the theory of the latent heat of condensation from precipitation originally devised by Espy to explain cumulus clouds and thunderstorms. The components w and w_3, Table 17, show that there is an ascending current in the Tropics, and a descending current in the higher latitudes. Thus, as the result of the theoretical discussion in general, the canal theory has several of its features verified, and yet there are serious discrepancies inherent in both Ferrel's and Oberbeck's solutions.

My statement has suggested by implication that there exists an important principle which has been neglected by these meteorologists. They have each discussed the general and the local cyclones as if they were in a sense *independent of one another*, since separate sources of heat energy are assigned to each, and two characteristic laws of circulation are deduced therefrom. It is much more natural to suppose that these two systems are mutually interdependent, and that the excess of energy of the general cyclone is transformed into the driving forces of the local circulation; also, that the acquired motion of the local cyclone reacts upon and retards the excess of motion of the general cyclone in the temperate zones. The subject becomes, however, excessively complex, and I can only attempt to sketch in general terms in my next paper an outline of this view, hoping some other time to be able to supplement it with a more suitable mathematical analysis, when the study of the observations now in hand has been advanced more nearly to completion.

REVISION OF WOLF'S SUN-SPOT RELATIVE-NUMBERS.

By Prof. A. WOLFER, Zurich, dated March 29, 1902.

The next number (XCIII) of the Astronomische Mittheilungen will contain a new edition of Wolf's table of relative numbers, in which not only will some inaccuracies of the earlier tables—partly errors of computation, partly typographical errors—be expunged, but those older observations that have come to light since the tables were compiled, but have not yet been worked up, will be used in the revision. For the most part these new observations were made at Kremsmünster during the years 1802–1830 and have furnished a very valuable addition to the record of sun spots. I now send you a copy of this corrected and completed series (Table 1), entitled "Observed sun-spot relative-numbers." This table, extending from 1749–1901, replaces that published by Wolf in 1880 in No. L of the Astronomische Mittheilungen, as well as the various copies which afterwards appeared in the Meteorologische Zeitschrift and in the Memorie della Societá degli Spettroscopisti Italiani. [It also replaces the table on pages 505–506, MONTHLY WEATHER REVIEW, November 1901.] It contains no error, and is now to be regarded as definitive so long as the complete new reduction of the whole amount of observational material is not executed, for which the preliminary work is now going on; this will, however, apparently require five or six years more.[1]

Those numbers in the above-mentioned table that are entered in heavy-faced type depend wholly on actual observations; those in light-faced type depend in great part upon actual observations, yet also have in part been obtained by means of graphic interpolations between the days of any month that contained observations with considerable gaps between them; the interpolated numbers were combined with the observed numbers in the computation of the monthly means. Only a very few monthly means, in the eighteenth century, depend entirely upon interpolations; by far the larger number are based upon actual observations. But every monthly mean in which even a single interpolated number has been used is shown by light-faced type; in this respect the distinction may have been too rigorous rather than indulgent, and the light-faced type are, therefore, in no sense to be regarded as an indication of the unreliability of the corresponding numbers.

I have thought that it would perhaps be agreeable to you also to possess new editions of the two other tables that are based upon the preceding, namely, the table of "Smoothed relative numbers" and that of the "Epochs of maxima and minima," which are directly deduced from the preceding. In No. XLII of his Astronomische Mittheilungen Wolf has published the smoothed numbers up to 1876, inclusive, and reproductions of these are found in various periodicals and other publications. But there are some errors of computation in this table, and numerous typographical errors occur in the reproductions.

The smoothed relative numbers of Table 2 present the mean course of the spot phenomena; that is to say, without the numerous secondary short-periodical variations that really occur in addition to the 11-year variation. Investigations into the general course of the phenomena and the periods of a higher order should, therefore, be based upon these smoothed numbers and not on those observed. The method of formation of these numbers has been explained by Wolf, in No. XLII of his Astronomische Mittheilungen. The mean of every twelve consecutive observed monthly relative numbers is taken, and every pair of two consecutive means is again united into one mean value according to the following scheme:

$1/12\ (\mathrm{I} + \mathrm{II} + \mathrm{III} \ldots\ldots + \mathrm{XII}) = n_1$, for epoch July 1.
$1/12\ (\mathrm{II} + \mathrm{III} + \mathrm{IV} \ldots\ldots + \mathrm{XII} + \mathrm{I}) = n_2$, for epoch August 1.
$1/2\ (n_1 + n_2) = r$, which is the smoothed number for mid-July.

This method of smoothing is conformable to that which Wolf has used for eliminating the annual period of the variations of magnetic declination when comparing the latter with the solar spots. This consideration was not necessary for the relative numbers but the combination of twelve months into one mean has been adopted in order to secure a uniform method of treating both phenomena. Table 2, which contains these

[1] As Professor Wolfer's revision furnishes us with sun-spot numbers that replace all previous publications the Editor has reproduced them in graphic form on figs. 2 and 3. In these figures the light line represents the observed numbers of Table 1, the heavy line the smoothed numbers of Table 2.—ED.

smoothed values, has been newly computed from beginning to end and is entirely free from error.

The epochs of maximum and minimum, as deduced from the new Table 2, are given in Table 3; they differ from those published by Wolf (No. LVI of his Mittheilungen) only in respect to the maximum of 1805, which, by reason of the newly added observations at Kremsmünster, is changed from 1804.2 to 1805.2. On the other hand, in the later reproductions of Wolf's table there are some typographical errors even in that which Wolf himself published in the year 1890, in the first volume of his Handbook of Astronomy. The present Table 3 is for the moment to be considered as definitive and free from error. I have attributed definite weights to the individual epochs, in order to indicate to those who make use of them some idea as to their reliability. The epochs since 1823, namely, since Schwabe's observations began, all receive the weight 10; for epochs preceding these I have again carefully checked the observational material on which they are based and compared them as to completeness and uniformity, and I believe that the estimate of relative reliability of the individual epochs which I have attained is not far from the truth. With the epochs and weights of Table 3, I have also newly computed the mean length of the 11-year period and the normal epochs of maximum and minimum; and find the values given in Table 3; these differ only very slightly from Professor Newcomb's results,[2] although the epochs used by him differ partly from the new ones, being older values such as Wolf had published in 1872, but had afterwards changed.

As concerns the 35-year period discovered by Dr. Lockyer, it is quite certain that the interval between each minimum and the following maximum, or the so-called duration of increase, as well as the duration of decrease of the sun-spot curve, shows variations in the different periods that are not accidental and that most probably have a periodic character. But I do not believe that the material used by Dr. Lockyer is sufficient to give the length of the greater period with any certainty, because the whole interval of time that Dr. Lockyer takes into consideration covered only one and a half of these greater periods of thirty-five years each. As soon as I received the memoir of Dr. Lockyer I at once investigated whether the existence of this suspected period could be traced backward. This attempt was thoroughly justified, because, at least since 1750, the epochs of maximum and minimum are relatively well ascertained and are much more reliable than Dr. Lockyer seems inclined to allow. With the exception of the years 1784 and 1788, which have the weight of 4 ascribed to them in Table 3, there is no other epoch whose uncertainty amounts to one-half year. In Table 4 you will find the result to which I at that time arrived; column a contains the interval of time elapsing between a minimum and the following maximum; these are therefore the numbers which, according to Dr. Lockyer, should follow a 35-year period; these are displayed graphically in curve I, fig. 1, and leave no doubt as to their variability; in fact, this variability seems to be much stronger than Dr. Lockyer found from the periods used by him. Apparently, they vary to and fro, but a constant period can not be found therein. The great variation between 1780 and 1835 would in fact rather point to the period of fifty-five years, which was previously suspected by Wolf, and would in no case make a 35-year period probable.

Dr. Halm of Edinburg[3] has also drawn attention to the variability of the interval between minima and maxima, and in fact this variability is still more plainly brought out by the method of treatment adopted by him, in that he takes account of the ratio of the ascending to the descending part of the 11-year spot period, instead of considering the absolute duration of the ascending portion, as Dr. Lockyer has done. The accompanying Table 4 contains, the interval of time, b, between the maximum and the following minimum, as also the ratio a/b; the latter is also shown graphically in curve II, fig. 1 The variability of the ratio a/b is very striking, and shows in general the same course as in curve I, but there is no indication of a regular recurring period, and especially one of thirty-five years.

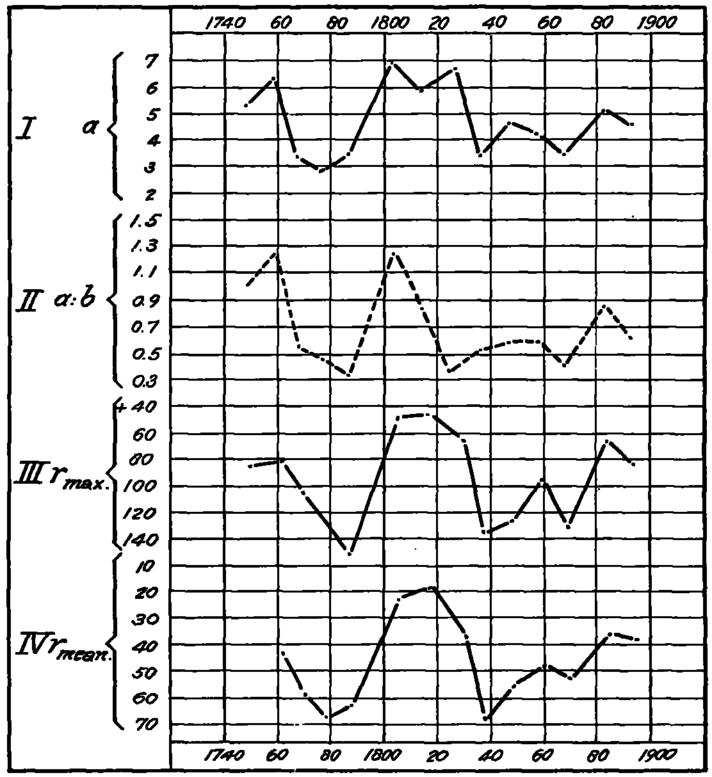

FIG. 1.

Only one result which Dr. Lockyer has brought out is certain, and one which was also demonstrated by Dr. Halm, both from the observed facts and as a consequence of his new theory of the periodicity of the solar phenomena: namely, that the just-mentioned variations of a and of the ratio a/b proceed parallel with the intensity of the development of the spots through each 11-year period in that a maximum follows a minimum quicker in proportion as the maximum is higher, or as Dr. Halm expresses it—"in the individual spot periods the maximum occurs earlier in proportion as the development of the spots is more rapid." Dr. Halm has compared the ratio a/b with the absolute altitude of the individal maxima, as expressed by Wolf's relative numbers; on the other hand, Dr. Lockyer bases his position on the total sum of the spotted area for each individual period. We attain to the same results if, for comparison, we use the mean annual relative number for a single 11-year period, namely, the sum total of the annual relative numbers for the whole period divided by the length of the period, therefore, $r_{mean} = \frac{\Sigma r}{P}$. The curves III and IV, fig. 1, present the values of $r_{max.}$ and r_{mean}. As we see, the agreement with I and II is quite remarkable. That the interval between minima and maxima depends intimately upon the intensity of development of the spots during that period would seem therefore to be quite certain, according to Lockyer's and Halm's investigations; both these quantities are subject to variations of an apparently periodic character; but it seems to me that the material actually available does not indicate a somewhat regular periodicity; and that the continued existence of a 35-year period is not yet demonstrated.

[2] Astrophysical Journal, XIII, No. 1.
[3] Astronomische Nachrichten No. 3723.

TABLE 1.—*Observed sun-spot relative numbers.*

Revision of March, 1902, by Prof. A. Wolfer.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.
1749 ...	58.0	62.6	70.0	55.7	85.0	83.5	94.8	66.3	75.9	75.5	158.6	85.2	80.9
1750 ...	73.3	75.9	89.2	88.3	90.0	100.0	85.4	103.0	91.2	65.7	63.3	75.4	83.4
1751 ...	70.0	43.5	45.3	56.4	60.7	50.7	66.3	59.8	23.5	23.2	28.5	44.0	47.7
1752 ...	35.0	50.0	71.0	59.3	59.7	39.6	78.4	29.3	27.1	46.6	37.6	40.0	47.8
1753 ...	44.0	32.0	45.7	38.0	36.0	31.7	22.0	39.0	28.0	25.0	20.0	6.7	30.7
1754 ...	0.0	3.0	1.7	13.7	20.7	26.7	18.8	12.3	8.2	24.1	13.2	4.2	12.2
1755 ...	10.2	11.2	6.8	6.5	0.0	0.0	8.6	3.2	17.8	23.7	6.8	20.0	9.6
1756 ...	12.5	7.1	5.4	9.4	12.5	12.9	3.6	6.4	11.8	14.3	17.0	9.4	10.2
1757 ...	14.1	21.2	26.2	30.0	38.1	12.8	25.0	51.3	39.7	32.5	64.7	33.5	32.4
1758 ...	37.6	52.0	49.0	72.3	46.4	45.0	44.0	38.7	62.5	37.7	43.0	43.0	47.6
1759 ...	48.3	44.0	46.8	47.0	49.0	50.0	51.0	71.3	77.2	59.7	46.3	57.0	54.0
1760 ...	67.3	59.5	74.7	58.3	72.0	48.3	66.0	75.6	61.3	50.6	59.7	61.0	62.9
1761 ...	70.0	91.0	80.7	71.7	107.2	99.3	94.1	91.1	100.7	88.7	89.7	46.0	85.9
1762 ...	43.8	72.8	45.7	60.2	39.9	77.1	33.8	67.7	68.5	69.3	77.8	77.2	61.2
1763 ...	56.5	31.9	34.2	32.9	32.7	35.8	54.2	26.5	68.1	46.3	60.9	61.4	45.1
1764 ...	59.7	59.7	40.2	34.4	44.3	30.0	30.0	30.0	28.2	28.0	26.0	25.7	36.4
1765 ...	24.0	26.0	25.0	22.0	20.2	20.0	27.0	29.7	16.0	14.0	14.0	13.0	20.9
1766 ...	12.0	11.0	36.6	6.0	26.8	3.0	3.3	4.0	4.3	5.0	5.7	19.2	11.4
1767 ...	27.4	30.0	43.0	32.9	29.8	33.3	21.9	40.8	42.7	44.1	54.7	53.3	37.8
1768 ...	53.5	66.1	46.3	42.7	77.7	77.4	52.6	66.8	74.8	77.8	90.6	111.8	69.8
1769 ...	73.9	64.2	64.3	96.7	73.6	94.4	118.6	120.3	148.8	158.2	148.1	112.0	106.1
1770 ...	104.0	142.5	80.1	51.0	70.1	83.3	109.8	126.3	104.4	103.6	132.2	102.3	100.8
1771 ...	36.0	46.2	46.7	64.9	152.7	119.5	67.7	58.5	101.4	90.0	99.7	95.7	81.6
1772 ...	100.9	90.8	31.1	92.2	38.0	57.0	77.3	56.2	50.5	78.6	61.3	64.0	66.5
1773 ...	54.6	29.0	51.2	32.9	41.1	28.4	27.7	12.7	29.3	26.5	40.9	43.2	34.8
1774 ...	46.8	65.4	55.7	43.8	51.3	28.5	17.5	6.6	7.9	14.0	17.7	12.2	30.6
1775 ...	4.4	0.0	11.6	11.2	3.9	12.3	1.0	7.9	3.2	5.6	15.1	7.9	7.0
1776 ...	21.7	11.6	6.3	21.8	11.2	19.0	1.0	24.2	16.0	30.0	35.0	40.0	19.8
1777 ...	45.0	36.5	39.0	95.5	80.3	80.7	95.0	112.0	116.2	106.5	146.0	157.3	92.5
1778 ...	177.3	109.3	134.0	145.0	238.9	171.6	153.0	140.0	171.7	156.3	150.3	105.0	154.4
1779 ...	114.7	165.7	118.0	145.0	140.0	113.7	143.0	112.0	111.0	124.0	114.0	110.0	125.9
1780 ...	70.0	98.0	98.0	95.0	107.2	88.0	86.0	86.0	93.7	77.0	60.0	58.7	84.8
1781 ...	98.7	74.7	53.0	68.3	104.7	97.7	73.5	66.0	51.0	27.3	67.0	35.2	68.1
1782 ...	54.0	37.5	37.0	41.0	54.3	38.0	37.0	44.0	34.0	23.2	31.5	30.0	38.5
1783 ...	28.0	38.7	26.7	28.3	23.0	25.2	32.2	20.0	18.0	8.0	15.0	10.5	22.8
1784 ...	13.0	8.0	11.0	10.0	6.0	9.0	6.0	10.0	10.0	8.0	17.0	14.0	10.2
1785 ...	6.5	8.0	9.0	15.7	20.7	26.3	36.3	20.0	32.0	47.2	40.2	27.3	24.1
1786 ...	37.2	47.6	47.7	85.4	92.3	59.0	83.0	89.7	111.5	112.3	116.0	112.7	82.9
1787 ...	134.7	106.0	87.4	127.2	134.8	99.2	128.0	137.2	157.3	157.0	141.5	174.0	132.0
1788 ...	138.0	129.2	143.3	108.5	113.0	154.2	141.5	136.0	141.0	142.0	94.7	129.5	130.9
1789 ...	114.0	125.3	120.0	123.3	123.5	120.0	117.0	103.0	112.0	89.7	134.0	135.5	118.1
1790 ...	103.0	127.5	96.3	94.0	93.0	91.0	69.3	87.0	77.3	84.3	82.0	74.0	89.9
1791 ...	72.7	62.0	74.0	77.2	73.7	64.2	71.0	43.0	66.5	61.7	67.0	66.0	66.6
1792 ...	58.0	64.0	63.0	75.7	62.0	61.0	45.8	60.0	59.0	59.0	57.0	56.0	60.0
1793 ...	56.0	55.0	55.5	53.0	52.3	51.0	50.0	29.3	24.0	47.0	44.0	45.7	46.9
1794 ...	45.0	44.0	38.0	28.4	55.7	41.5	41.0	40.0	11.1	28.5	67.4	51.4	41.0
1795 ...	21.4	39.9	12.6	18.6	31.0	17.1	12.9	25.7	13.5	19.5	25.0	18.0	21.3
1796 ...	22.0	23.8	15.7	31.7	21.0	6.7	26.9	1.5	18.4	11.0	8.4	5.1	16.0
1797 ...	14.4	4.2	4.0	4.0	7.3	11.1	4.3	6.0	5.7	6.9	5.8	3.0	6.4
1798 ...	2.0	4.0	12.4	1.1	0.0	0.0	0.0	3.0	2.4	1.5	12.5	9.9	4.1
1799 ...	1.6	12.6	21.7	8.4	8.2	10.6	2.1	0.0	0.0	4.6	2.7	8.6	6.8
1800 ...	6.9	9.3	13.9	0.0	5.0	23.7	21.0	19.5	11.5	12.3	10.5	40.1	14.5
1801 ...	27.0	29.0	30.0	31.0	32.0	31.2	35.0	38.7	33.5	32.6	39.8	48.2	34.0
1802 ...	47.8	47.0	40.8	42.0	44.0	46.0	48.0	50.0	51.8	38.5	34.5	50.0	45.0
1803 ...	50.0	50.8	29.5	25.0	44.3	36.0	48.3	34.1	45.3	54.3	51.0	48.0	43.1
1804 ...	45.3	48.3	48.0	50.6	33.4	34.8	29.8	43.1	53.0	62.3	61.0	60.0	47.5
1805 ...	61.0	44.1	51.4	37.5	39.0	40.5	37.6	42.7	44.4	29.4	41.0	38.3	42.2
1806 ...	39.0	29.6	32.7	27.7	26.4	25.6	30.0	26.3	24.0	27.0	25.0	24.0	28.1
1807 ...	12.0	12.2	9.6	23.8	10.0	12.0	12.7	12.0	5.7	8.0	2.6	0.0	10.1
1808 ...	0.0	4.5	0.0	12.3	13.5	13.5	6.7	8.0	11.7	4.7	10.5	12.3	8.1
1809 ...	7.2	9.2	0.9	2.5	2.0	7.7	0.3	0.2	0.4	0.0	0.0	0.0	2.5
1810 ...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1811 ...	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	2.4	6.1	0.8	1.1	1.4
1812 ...	11.3	1.9	0.7	0.0	1.0	1.3	0.5	15.6	5.2	3.9	7.9	10.1	5.0
1813 ...	0.0	10.3	1.9	16.6	5.5	11.2	18.3	8.4	15.3	27.8	16.7	14.3	12.2
1814 ...	22.2	12.0	5.7	23.8	5.8	14.9	18.5	2.3	8.1	19.3	14.5	20.1	13.9
1815 ...	19.2	32.2	26.2	31.6	9.8	55.9	35.5	47.2	31.5	33.5	37.2	65.0	35.4
1816 ...	26.3	68.8	73.7	58.8	44.3	43.6	38.8	23.2	47.8	56.4	38.1	29.9	45.8
1817 ...	36.4	57.9	96.2	26.4	21.2	40.0	50.0	45.0	36.7	25.6	28.9	28.4	41.1
1818 ...	34.9	22.4	29.7	34.5	53.1	36.4	28.0	31.5	26.1	31.7	10.9	25.8	30.4
1819 ...	32.5	20.7	3.7	20.2	19.6	35.0	31.4	26.1	14.9	27.5	25.1	30.6	23.9
1820 ...	19.2	26.6	4.5	19.4	29.3	10.8	20.6	25.9	5.2	9.0	7.9	9.7	15.7
1821 ...	21.5	4.3	5.7	9.2	1.7	1.8	2.5	4.8	4.4	18.8	4.4	0.0	6.6
1822 ...	0.0	0.9	16.1	13.5	1.5	5.6	7.9	2.1	0.0	0.4	0.0	0.0	4.0
1823 ...	0.0	0.0	0.6	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	20.4	1.8
1824 ...	21.6	10.8	0.0	19.4	2.8	0.0	0.0	1.4	20.5	25.2	0.0	0.8	8.5
1825 ...	5.0	15.5	22.4	3.8	15.4	15.4	30.9	25.4	15.7	15.6	11.7	22.0	16.6
1826 ...	17.7	18.2	36.7	24.0	32.4	37.1	52.5	39.6	18.9	50.6	39.5	68.1	36.3
1827 ...	34.6	47.4	57.8	46.0	56.3	56.7	42.9	53.7	49.6	57.2	48.2	46.1	49.7
1828 ...	52.8	64.4	65.0	61.1	89.1	98.0	54.3	76.4	50.4	34.7	57.0	46.9	62.5
1829 ...	43.0	49.4	72.3	95.0	67.5	73.9	90.8	78.3	52.8	57.2	67.6	56.5	67.0
1830 ...	52.2	72.1	84.6	107.1	66.3	65.1	43.9	50.7	62.1	84.4	81.2	82.1	71.0
1831 ...	47.5	50.1	93.4	54.6	38.1	33.4	45.2	54.9	37.9	46.2	43.5	28.9	47.8
1832 ...	30.9	55.5	55.1	26.9	41.3	26.7	13.9	8.9	8.2	21.1	14.3	27.5	27.5
1833 ...	11.3	14.9	11.8	2.8	12.9	1.0	7.0	5.7	11.6	7.5	5.9	9.9	8.5
1834 ...	4.9	18.1	3.9	1.4	8.8	7.8	8.7	4.0	11.5	24.8	30.5	34.5	13.2
1835 ...	7.5	24.5	19.7	61.5	43.6	33.2	59.8	59.0	100.8	95.2	100.0	77.5	56.9
1836 ...	88.6	107.6	98.1	142.9	111.4	124.7	116.7	107.8	95.1	137.4	120.9	206.2	121.5
1837 ...	188.0	175.6	134.6	138.2	111.3	158.0	162.8	134.0	96.3	123.7	107.0	129.8	138.3
1838 ...	144.9	84.8	140.8	126.6	137.6	94.5	108.2	78.8	73.6	90.8	77.4	79.8	103.2
1839 ...	107.6	102.5	77.7	61.8	53.8	54.6	84.7	131.2	132.7	90.8	68.8	63.6	85.8
1840 ...	81.2	87.7	55.5	65.9	69.2	48.5	60.7	57.8	74.0	49.8	54.3	53.7	63.2
1841 ...	24.0	29.9	29.7	42.6	67.4	55.7	30.8	39.3	35.1	28.5	19.8	38.8	36.8
1842 ...	20.4	22.1	21.7	26.9	24.9	20.5	12.6	26.5	18.5	38.1	40.5	17.6	24.2
1843 ...	13.3	3.5	8.3	8.8	21.1	10.5	9.5	11.8	4.2	5.3	19.1	12.7	10.7
1844 ...	9.4	14.7	13.6	20.8	12.0	3.7	21.2	23.9	6.9	21.5	10.7	21.6	15.0
1845 ...	25.7	43.6	43.3	56.9	47.8	31.1	30.6	32.3	29.6	40.7	39.4	59.7	40.1
1846 ...	38.7	51.0	63.9	69.2	59.9	65.1	46.5	54.8	107.1	55.9	60.4	65.5	61.5
1847 ...	62.6	44.9	85.7	44.7	75.4	85.3	52.2	140.6	161.2	180.4	138.9	109.6	98.5
1848 ...	159.1	111.8	108.9	107.1	102.2	123.8	139.2	132.5	100.3	132.4	114.6	159.9	124.3
1849 ...	156.7	131.7	96.5	102.5	80.6	81.2	78.0	61.3	93.7	71.5	99.7	97.0	95.9
1850 ...	78.0	89.4	82.6	44.1	61.6	70.0	39.1	61.6	86.2	71.0	54.8	60.0	66.5
1851 ...	75.5	105.4	64.6	56.5	63.6	63.2	36.1	57.4	67.9	62.5	50.9	71.4	64.5

TABLE I.—*Observed sun-spot relative numbers*—Continued.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.
1852 ...	68.4	67.5	61.2	65.4	54.9	46.9	42.0	39.7	37.5	67.3	54.3	45.4	54.2
1853 ...	41.1	42.9	37.7	47.6	34.7	40.0	45.9	50.4	33.5	42.3	28.8	23.4	39.0
1854 ...	15.4	20.0	20.7	26.4	24.0	21.1	18.7	15.8	22.4	12.7	28.2	21.4	20.6
1855 ...	12.3	11.4	17.4	4.4	9.1	5.3	0.4	3.1	0.0	9.7	4.2	3.1	6.7
1856 ...	0.5	4.9	0.4	6.5	0.0	5.0	4.6	5.9	4.4	4.5	7.7	7.2	4.3
1857 ...	13.7	7.4	5.2	11.1	29.2	16.0	22.2	16.9	42.4	40.6	31.4	37.2	22.8
1858 ...	39.0	34.9	57.5	38.3	41.4	44.5	56.7	55.3	80.1	91.2	51.9	66.9	54.8
1859 ...	83.7	87.6	90.3	85.7	91.0	87.1	95.2	106.8	105.8	114.6	97.2	81.0	93.8
1860 ...	81.5	88.0	98.9	71.4	107.1	108.6	116.7	100.3	92.2	90.1	97.9	95.6	95.7
1861 ...	62.3	77.8	101.0	98.5	56.8	87.8	78.0	82.5	79.9	67.2	53.7	80.5	77.2
1862 ...	63.1	64.5	43.6	53.7	64.4	84.0	73.4	62.5	66.6	42.0	50.6	40.9	59.1
1863 ...	48.3	56.7	66.4	40.6	53.8	40.8	32.7	48.1	22.0	39.9	37.7	41.2	44.0
1864 ...	57.7	47.1	66.3	35.8	40.6	57.8	54.7	54.8	28.5	33.9	57.6	28.6	47.0
1865 ...	48.7	39.3	39.5	29.4	34.5	33.6	26.8	37.8	21.6	17.1	24.6	12.8	30.5
1866 ...	31.6	38.4	24.6	17.6	12.9	16.5	9.3	12.7	7.3	14.1	9.0	1.5	16.3
1867 ...	0.0	0.7	9.2	5.1	2.9	1.5	5.0	4.9	9.8	13.5	9.3	25.2	7.3
1868 ...	15.6	15.8	26.5	36.6	26.7	31.1	28.6	34.4	43.8	61.7	59.1	67.6	37.3
1869 ...	60.9	59.3	52.7	41.0	104.0	108.4	59.2	79.6	80.6	59.4	77.4	104.3	73.9
1870 ...	77.3	114.9	159.4	160.0	176.0	135.6	132.4	153.8	136.0	146.4	147.5	130.0	139.1
1871 ...	88.3	125.3	143.2	162.4	145.5	91.7	103.0	110.0	80.3	89.0	105.4	90.3	111.2
1872 ...	79.5	120.1	88.4	102.1	107.6	109.9	105.5	92.9	114.6	103.5	112.0	83.9	101.7
1873 ...	86.7	107.0	98.3	76.2	47.9	44.8	66.9	68.2	47.5	47.4	55.4	49.2	66.3
1874 ...	60.8	64.2	46.4	32.0	44.6	38.2	67.8	61.3	28.0	34.3	28.9	29.3	44.7
1875 ...	14.6	22.2	33.8	29.1	11.5	23.9	12.5	14.6	2.4	12.7	17.7	9.9	17.1
1876 ...	14.3	15.0	31.2	2.3	5.1	1.6	15.2	8.8	9.9	14.3	9.9	8.2	11.3
1877 ...	24.4	8.7	11.7	15.8	21.2	13.4	5.9	6.3	16.4	6.7	14.5	2.3	12.3
1878 ...	3.3	6.0	7.8	0.1	5.8	6.4	0.1	0.0	5.3	1.1	4.1	0.5	3.4
1879 ...	0.8	0.6	0.0	6.2	2.4	4.8	7.5	10.7	6.1	12.3	12.9	7.2	6.0
1880 ...	24.0	27.5	19.5	19.3	23.5	34.1	21.9	48.1	66.0	43.0	30.7	29.6	32.3
1881 ...	36.4	53.2	51.5	51.7	43.5	60.5	76.9	58.0	53.2	64.0	54.8	47.3	54.3
1882 ...	45.0	69.3	67.5	95.8	64.1	45.2	45.4	40.4	57.7	59.2	84.4	41.8	59.7
1883 ...	60.6	46.9	42.8	82.1	32.1	76.5	80.6	46.0	52.6	83.8	84.5	75.9	63.7
1884 ...	91.5	86.9	86.8	76.1	66.5	51.2	53.1	55.8	61.9	47.8	36.6	47.2	63.5
1885 ...	42.8	71.8	49.8	55.0	73.0	83.7	66.5	50.0	39.6	38.7	33.3	21.7	52.2
1886 ...	29.9	25.9	57.3	43.7	30.7	27.1	30.3	16.9	21.4	8.6	0.3	12.4	25.4
1887 ...	10.3	13.2	4.2	6.9	20.0	15.7	23.3	21.4	7.4	6.6	6.9	20.7	13.1
1888 ...	12.7	7.1	7.8	5.1	7.0	7.1	3.1	2.8	8.8	2.1	10.7	6.7	6.8
1889 ...	0.8	8.5	7.0	4.3	2.4	6.4	9.7	20.6	6.5	2.1	0.2	6.7	6.3
1890 ...	5.3	0.6	5.1	1.6	4.8	1.3	11.6	8.5	17.2	11.2	9.6	7.8	7.1
1891 ...	13.5	22.2	10.4	20.5	41.1	48.3	58.8	33.2	53.8	51.5	41.9	32.2	35.6
1892 ...	69.1	75.6	49.9	69.6	79.6	76.3	76.8	101.4	62.8	70.5	65.4	78.6	73.0
1893 ...	75.0	73.0	65.7	88.1	84.7	88.2	88.8	129.2	77.9	79.7	75.1	93.8	84.9
1894 ...	83.2	84.6	52.3	81.6	101.2	98.9	106.0	70.3	65.9	75.5	56.6	60.0	78.0
1895 ...	63.3	67.2	61.0	76.9	67.5	71.5	47.8	68.9	57.7	67.9	47.2	70.7	64.0
1896 ...	29.0	57.4	52.0	43.8	27.7	49.0	45.0	27.2	61.3	28.4	38.0	42.6	41.8
1897 ...	40.6	29.4	29.1	31.0	20.0	11.3	27.6	21.8	48.1	14.3	8.4	33.3	26.2
1898 ...	30.2	36.4	38.3	14.5	25.8	22.3	9.0	31.4	34.8	34.4	30.9	12.6	26.7
1899 ...	19.5	9.2	18.1	14.2	7.7	20.5	13.5	2.9	8.4	13.0	7.8	10.5	12.1
1900 ...	9.4	13.6	8.6	16.0	15.2	12.1	8.3	4.3	8.3	12.9	4.5	0.3	9.5
1901 ...	0.2	2.4	4.5	0.0	10.2	5.8	0.7	1.0	0.6	3.7	3.8	0.0	2.7

TABLE 2.—*Smoothed sun-spot relative numbers.*

Revision of March, 1902, by Prof. A. Wolfer.

1749 ...	.....	.....	.....	.....	.....	.....	81.6	82.8	84.1	86.3	87.8	88.7	.....
1750 ...	89.0	90.2	92.3	92.6	88.2	83.8	83.3	81.8	78.6	75.4	72.9	69.6	83.1
1751 ...	66.8	64.2	59.5	54.9	51.7	49.0	46.2	45.0	46.4	47.5	47.6	47.1	52.2
1752 ...	47.2	46.4	45.3	46.4	47.8	48.0	48.2	47.8	46.0	44.1	42.2	40.9	45.9
1753 ...	38.2	36.2	36.7	35.8	34.2	32.1	28.8	25.8	22.8	19.9	18.3	17.4	28.9
1754 ...	17.1	15.8	13.9	13.0	12.7	12.3	12.6	13.4	14.0	13.9	12.7	10.7	13.5
1755 ...	9.2	8.4	8.4	8.8	8.5	8.9	9.7	9.6	9.4	9.4	10.1	11.1	9.3
1756 ...	11.5	11.4	11.3	10.6	10.7	10.6	10.3	10.9	12.4	14.1	16.0	17.1	12.2
1757 ...	18.0	20.7	23.8	25.7	28.4	31.4	33.4	35.7	37.9	40.6	42.7	44.4	31.9
1758 ...	46.5	46.8	47.2	48.4	47.7	47.2	48.0	48.2	47.7	46.6	45.6	46.0	47.2
1759 ...	46.5	48.1	50.1	51.5	52.7	53.4	54.8	56.2	58.0	59.6	61.1	62.0	54.5
1760 ...	62.5	63.3	62.8	61.8	62.0	62.7	63.0	64.4	66.0	66.8	68.8	72.4	64.7
1761 ...	75.7	77.5	79.8	83.0	85.9	86.5	84.8	82.9	80.7	78.8	75.5	71.7	80.2
1762 ...	68.3	64.8	62.5	60.4	59.0	59.9	61.7	60.5	58.3	56.7	55.3	53.2	60.1
1763 ...	52.4	51.5	49.8	48.8	47.1	45.8	45.3	46.5	48.0	48.3	48.8	49.1	48.5
1764 ...	47.8	46.9	45.4	43.0	40.8	37.8	34.9	32.0	29.9	28.8	27.3	25.8	36.7
1765 ...	25.3	25.2	24.6	23.6	22.5	21.4	20.4	19.3	19.1	19.0	18.6	18.1	21.4
1766 ...	16.4	14.4	12.8	12.0	11.2	11.2	12.1	13.5	14.5	15.9	17.2	18.6	14.2
1767 ...	20.6	22.9	26.0	29.3	32.9	36.4	38.9	41.5	43.1	43.7	46.1	49.9	35.9
1768 ...	53.0	55.4	57.8	60.6	63.5	67.4	70.7	71.5	72.1	75.1	77.2	77.8	66.8
1769 ...	81.2	86.2	91.5	97.9	103.7	106.1	107.3	111.9	115.8	114.5	112.5	111.9	103.4
1770 ...	111.1	110.9	109.3	105.2	102.3	101.2	98.0	91.1	85.7	84.9	88.9	93.9	98.5
1771 ...	93.6	89.1	86.1	85.4	83.5	81.9	84.3	88.9	90.1	90.5	86.9	79.5	86.7
1772 ...	77.3	77.6	75.4	72.8	70.7	67.8	64.6	60.1	58.3	56.7	54.3	53.3	65.7
1773 ...	50.0	46.1	43.5	40.4	37.4	35.6	34.5	35.6	37.3	38.0	38.9	39.3	39.7
1774 ...	38.9	38.2	37.1	35.6	34.2	31.9	28.9	24.4	19.8	16.6	13.3	10.6	27.5
1775 ...	9.3	8.6	8.5	7.9	7.5	7.2	7.7	8.9	9.2	9.4	10.2	10.7	8.8
1776 ...	11.0	11.7	12.9	14.5	16.3	18.5	20.8	22.8	25.2	29.6	35.6	41.0	21.7
1777 ...	47.5	55.1	62.9	70.3	78.1	87.6	98.0	106.6	113.6	119.6	128.2	138.6	92.2
1778 ...	144.8	148.4	151.9	156.3	158.5	156.5	151.8	151.5	153.2	152.5	148.4	141.9	151.3
1779 ...	139.0	137.5	133.8	129.9	127.0	125.7	124.1	119.4	115.7	112.8	109.4	106.9	123.4
1780 ...	103.5	100.0	98.2	95.5	91.3	86.9	86.0	86.2	83.4	80.4	79.2	79.5	89.2
1781 ...	79.4	78.0	75.4	71.5	69.8	69.1	66.2	62.8	60.6	58.8	55.6	51.0	66.5
1782 ...	47.0	44.5	42.9	42.0	40.4	38.7	37.4	36.3	36.0	35.0	33.2	31.3	38.7
1783 ...	30.6	29.4	27.7	26.4	25.1	23.6	22.2	20.3	18.3	16.9	15.5	14.1	22.5
1784 ...	12.3	10.8	10.0	9.7	9.8	10.0	9.9	9.6	9.5	9.7	10.5	11.9	10.3
1785 ...	13.9	15.5	16.9	19.4	22.0	23.5	25.4	28.3	31.6	36.1	42.0	46.3	26.7
1786 ...	49.6	54.5	60.7	66.7	72.6	79.3	86.9	93.4	97.5	100.9	104.4	107.9	81.2
1787 ...	111.4	115.3	119.2	123.0	125.9	129.5	132.2	133.3	136.6	138.0	136.4	137.8	128.2
1788 ...	140.7	141.2	140.4	139.1	136.6	132.8	129.9	128.7	127.6	127.3	128.3	127.3	133.3
1789 ...	124.9	122.5	119.9	116.5	116.0	117.9	117.7	117.3	116.4	114.2	111.7	109.2	117.0
1790 ...	106.0	103.4	101.2	99.6	97.2	92.5	88.6	84.6	81.0	79.4	77.8	75.9	90.6
1791 ...	74.9	73.1	70.8	69.4	67.9	66.9	66.0	65.4	65.1	64.5	64.0	63.4	67.6
1792 ...	62.2	61.9	62.2	61.8	61.3	60.5	60.0	59.5	58.8	57.6	56.2	55.4	59.8
1793 ...	55.1	54.0	51.3	49.3	48.3	47.3	46.4	45.5	44.3	42.6	41.7	41.4	47.3
1794 ...	40.7	40.7	40.7	39.3	39.6	40.8	40.0	38.9	37.6	36.2	34.7	32.7	38.5
1795 ...	30.5	28.7	28.2	28.0	25.8	22.7	21.3	20.6	20.1	20.8	20.9	20.1	24.0
1796 ...	20.2	19.8	19.0	18.8	17.8	16.6	15.7	14.6	13.3	11.6	9.9	9.5	15.6

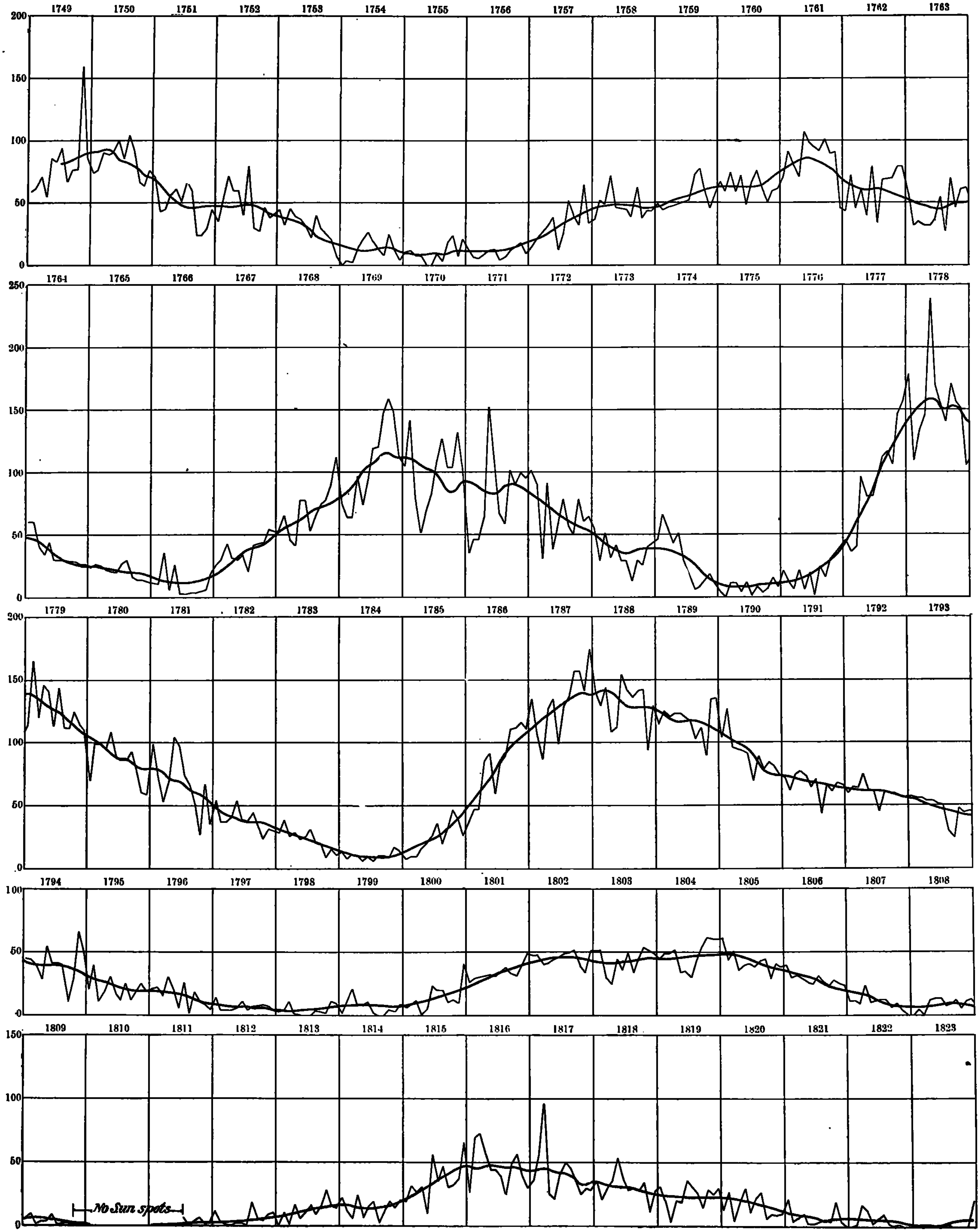

FIG. 2.—Sun-spot relative numbers.

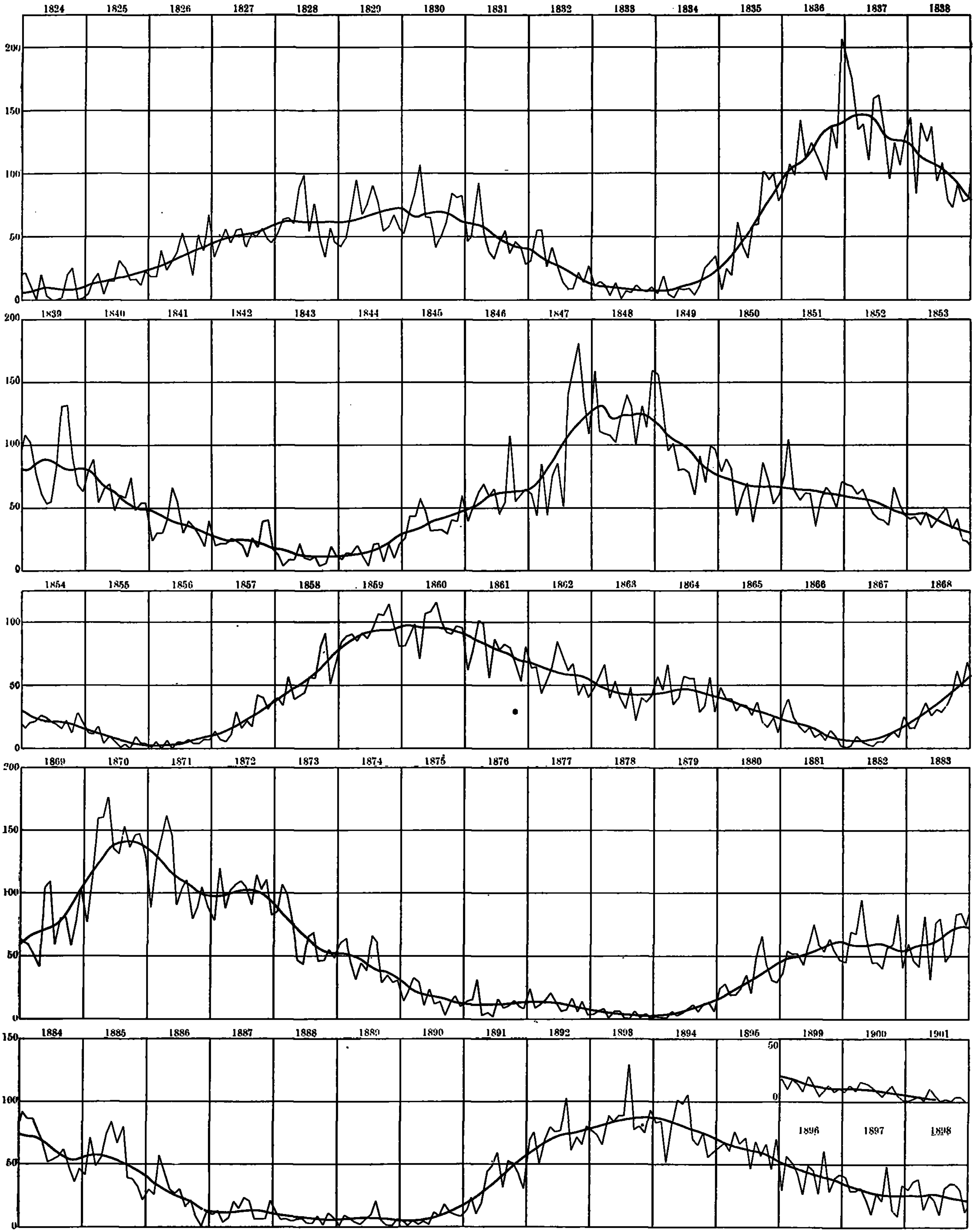

FIG. 3.—Sun-spot relative numbers.

TABLE 2—*Smoothed sun-spot relative numbers*—Continued.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.
1797 ...	8.8	8.0	7.7	7.0	6.7	6.5	5.9	5.4	5.7	5.9	5.5	4.7	6.5
1798 ...	4.1	3.8	3.5	3.2	3.2	3.8	4.1	4.4	5.1	5.8	6.5	7.3	4.6
1799 ...	7.8	7.8	7.5	7.6	7.3	6.8	7.0	7.1	6.6	5.9	5.4	5.9	6.9
1800 ...	7.2	8.8	10.1	10.9	11.5	13.2	15.3	17.0	18.5	20.4	22.8	24.3	15.0
1801 ...	25.2	26.6	28.3	30.0	32.1	33.7	34.9	36.5	37.7	38.6	39.6	40.7	33.7
1802 ...	41.8	42.8	44.1	45.1	45.1	45.0	45.1	45.4	45.1	43.9	43.2	42.8	44.1
1803 ...	42.4	41.7	40.8	41.2	42.5	43.1	42.9	42.6	43.2	45.1	45.7	45.2	43.0
1804 ...	44.3	44.0	44.6	45.3	46.1	47.0	48.1	48.6	48.6	48.2	47.9	48.3	46.8
1805 ...	48.9	49.2	48.8	47.1	44.9	43.1	41.3	39.8	38.4	37.2	36.3	35.2	42.5
1806 ...	34.2	33.2	31.7	30.7	30.0	28.7	27.0	25.1	23.0	22.3	21.5	20.2	27.3
1807 ...	18.9	17.6	16.3	14.7	13.0	11.1	9.6	8.7	8.0	7.1	6.8	7.0	11.6
1808 ...	6.8	6.4	6.5	6.6	6.8	7.6	8.4	8.9	9.2	8.8	7.9	7.2	7.6
1809 ...	6.7	6.1	5.3	4.6	4.0	3.0	2.2	1.6	1.1	1.0	0.8	0.4	3.1
1810 ...	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1811 ...	0.3	0.6	0.7	1.0	1.3	1.4	1.9	2.4	2.5	2.6	2.6	2.7	1.7
1812 ...	2.5	2.9	3.7	3.7	3.9	4.6	4.5	4.4	4.8	5.5	6.4	7.0	4.5
1813 ...	8.1	8.6	8.7	10.1	11.5	12.0	13.1	14.1	14.3	14.8	15.1	15.3	12.1
1814 ...	15.4	15.2	14.6	14.0	13.5	13.7	13.8	14.5	16.2	17.4	17.9	19.8	15.5
1815 ...	22.2	24.8	27.6	29.2	30.7	33.5	35.7	37.5	41.0	44.1	46.7	47.6	35.1
1816 ...	47.3	43.4	46.1	47.7	48.7	47.3	46.2	46.2	46.7	46.3	44.0	42.8	46.1
1817 ...	43.2	44.5	45.0	43.2	41.6	41.1	41.0	39.5	35.2	32.8	34.4	35.6	39.8
1818 ...	34.6	33.1	32.1	31.9	31.4	30.5	30.3	30.1	29.0	27.3	25.3	23.9	30.0
1819 ...	24.0	23.9	23.2	22.5	23.0	23.7	23.4	23.1	23.4	23.4	23.7	23.1	23.4
1820 ...	21.7	21.2	20.8	19.6	18.1	16.5	15.8	14.9	14.1	13.7	12.1	10.6	16.6
1821 ...	9.5	7.8	6.9	7.3	7.5	7.0	5.7	4.7	5.0	5.6	5.7	5.9	6.6
1822 ...	6.3	6.4	6.1	5.1	4.2	4.0	4.0	4.0	3.3	2.1	1.4	1.2	4.0
1823 ...	0.6	0.2	0.1	0.1	0.1	0.9	2.7	4.0	4.5	5.3	6.2	6.3	2.6
1824 ...	6.3	6.3	7.2	9.1	10.2	9.4	7.9	7.4	8.5	8.8	8.6	9.8	8.3
1825 ...	11.7	14.0	14.8	14.2	14.3	15.7	17.1	17.7	18.4	19.9	21.4	23.0	16.9
1826 ...	24.9	26.3	27.1	28.7	31.3	34.4	37.0	38.9	41.0	42.8	44.7	46.5	35.3
1827 ...	46.9	47.1	49.0	50.5	51.2	50.6	50.5	51.9	52.9	53.9	55.9	59.0	51.6
1828 ...	61.2	62.6	63.6	62.6	62.1	62.5	62.1	61.1	60.7	62.5	63.0	61.1	62.1
1829 ...	61.6	63.2	63.4	64.4	65.8	66.6	67.4	68.7	70.2	71.2	71.7	71.3	67.1
1830 ...	68.9	65.8	65.1	66.6	68.3	69.9	70.8	69.7	69.1	67.3	63.9	61.4	67.2
1831 ...	60.2	60.4	59.6	57.0	53.8	50.0	47.1	46.7	45.3	42.5	41.5	41.4	50.5
1832 ...	39.8	36.6	33.4	31.1	28.9	27.6	26.7	24.2	20.7	17.9	15.7	13.5	26.3
1833 ...	12.1	11.7	11.7	11.3	10.3	9.3	8.3	8.1	7.9	7.5	7.3	7.4	9.4
1834 ...	7.8	7.8	7.7	8.4	10.2	12.2	13.4	13.7	14.7	17.8	21.8	24.3	13.3
1835 ...	27.5	31.9	37.9	44.6	50.4	55.1	60.2	67.1	73.8	80.5	86.7	93.3	59.1
1836 ...	99.5	103.9	105.7	107.2	109.9	116.1	125.6	132.6	136.9	138.2	138.0	139.4	121.1
1837 ...	142.7	145.8	146.9	146.4	145.2	141.5	136.5	130.9	127.4	127.2	127.8	126.2	137.0
1838 ...	121.3	116.7	113.5	111.2	108.6	105.2	101.6	100.8	98.9	93.6	87.4	82.2	103.4
1839 ...	79.6	80.8	85.4	87.9	87.5	86.5	84.7	83.0	81.5	80.7	81.5	81.9	83.4
1840 ...	80.7	76.6	71.1	66.9	64.6	63.6	60.8	56.0	52.5	50.5	49.4	49.7	61.9
1841 ...	48.7	46.7	44.3	41.8	39.5	37.4	36.7	36.2	35.5	34.5	32.1	28.9	38.5
1842 ...	26.6	25.4	24.1	23.8	25.1	25.1	23.9	22.8	21.5	20.2	19.3	18.7	23.0
1843 ...	18.1	17.4	16.2	14.2	12.0	10.9	10.5	10.8	11.5	12.2	12.3	11.7	13.2
1844 ...	11.9	12.9	13.5	14.3	14.6	14.6	15.7	17.6	20.0	22.7	25.7	28.4	17.7
1845 ...	29.9	30.7	31.9	33.7	35.7	38.5	40.6	41.5	42.6	44.0	45.0	46.9	38.4
1846 ...	49.0	50.6	54.8	58.6	60.1	61.3	62.5	63.2	63.9	63.8	63.4	64.9	59.7
1847 ...	66.0	69.8	75.6	83.1	91.5	96.6	102.5	109.3	113.0	116.6	120.3	123.0	97.3
1848 ...	128.3	131.6	128.7	124.2	121.1	122.2	124.2	124.9	125.3	124.6	123.5	120.8	125.0
1849 ...	116.5	110.9	107.7	104.9	101.7	98.5	92.6	87.5	85.2	82.2	79.0	77.7	95.4
1850 ...	75.6	74.0	73.7	73.4	71.5	68.1	66.4	67.0	66.9	66.7	67.2	67.0	69.8
1851 ...	66.6	66.3	65.4	64.2	63.7	64.0	64.2	62.3	60.6	60.8	60.9	59.9	63.2
1852 ...	59.5	59.0	57.0	55.9	56.2	55.3	53.1	50.9	48.9	47.2	45.6	44.5	52.8
1853 ...	44.3	45.0	45.2	44.0	41.9	39.9	38.0	35.9	34.3	32.7	31.3	30.1	38.6
1854 ...	28.2	25.6	23.7	22.0	20.8	20.7	20.4	20.0	19.5	18.4	16.9	15.6	21.0
1855 ...	14.2	12.9	11.4	10.4	9.2	7.5	6.2	5.4	4.5	3.8	3.6	3.2	7.7
1856 ...	3.3	3.6	3.9	3.9	3.8	4.1	4.9	5.5	5.8	6.2	7.6	9.3	5.2
1857 ...	10.5	11.7	13.7	16.8	19.3	21.5	23.8	26.0	29.4	32.7	34.3	36.0	23.0
1858 ...	38.6	41.7	44.8	48.5	51.5	53.6	56.7	60.7	64.3	67.6	71.7	75.5	56.3
1859 ...	78.9	82.6	85.9	87.9	90.8	93.2	93.7	93.7	94.0	93.8	93.9	95.4	90.3
1860 ...	97.2	97.9	97.0	95.4	94.4	95.1	94.9	93.7	93.3	94.5	93.6	90.6	94.8
1861 ...	88.1	85.8	84.5	83.1	80.3	77.8	77.2	76.7	73.7	69.5	67.9	68.1	77.7
1862 ...	67.7	66.7	65.3	63.7	62.5	60.8	58.5	57.6	58.2	58.6	57.6	55.4	61.1
1863 ...	51.9	49.6	47.1	45.2	44.5	44.0	44.4	44.4	44.0	43.8	43.0	43.2	45.4
1864 ...	44.8	46.0	46.6	46.6	47.2	47.5	46.6	45.9	44.4	43.1	42.5	41.3	45.2
1865 ...	39.1	37.2	36.2	35.2	33.2	31.1	29.8	29.0	28.4	27.2	25.9	24.2	31.4
1866 ...	22.8	21.0	19.4	18.7	17.9	16.8	15.0	12.1	9.9	8.7	7.8	6.7	14.7
1867 ...	5.9	5.4	5.2	5.3	5.3	6.3	7.9	9.2	10.5	12.6	14.9	17.1	8.8
1868 ...	19.3	21.5	24.2	27.6	31.7	35.5	39.2	42.9	45.8	47.1	50.5	56.9	36.9
1869 ...	61.4	64.6	68.0	69.4	70.1	72.4	74.6	77.6	84.3	93.8	101.7	105.8	78.6
1870 ...	110.0	116.2	121.6	127.5	134.0	138.0	139.6	140.5	140.2	139.6	138.5	135.4	131.8
1871 ...	132.3	129.3	125.1	120.4	116.3	112.9	110.8	110.3	107.8	103.0	98.9	98.0	113.8
1872 ...	98.9	98.3	99.0	101.0	101.9	101.9	102.0	101.7	101.6	100.9	97.4	92.2	99.7
1873 ...	87.8	85.2	81.4	76.2	71.5	67.7	65.2	62.4	58.4	54.4	52.4	52.0	67.9
1874 ...	51.8	51.5	50.4	49.1	47.4	45.5	42.7	39.1	36.8	36.1	34.6	32.7	43.1
1875 ...	29.8	25.5	22.5	20.5	19.2	17.9	17.1	16.8	16.3	15.1	13.7	12.5	18.9
1876 ...	11.7	11.6	11.7	12.0	11.8	11.4	11.7	11.9	10.8	10.6	11.8	13.0	11.7
1877 ...	13.1	12.6	12.7	12.7	12.6	12.5	11.4	10.4	10.1	9.3	8.0	7.1	11.0
1878 ...	6.6	6.0	5.3	4.6	4.0	3.5	3.3	3.9	2.4	2.3	2.4	2.2	3.9
1879 ...	2.5	3.2	3.7	4.2	5.0	5.7	6.9	9.0	10.9	12.3	13.7	15.8	7.7
1880 ...	17.7	19.8	23.9	27.6	29.7	31.3	32.8	34.4	36.8	39.5	41.6	43.6	31.6
1881 ...	47.0	49.7	49.6	49.9	51.8	53.5	54.6	55.6	57.0	59.5	62.2	62.4	54.4
1882 ...	60.4	58.4	57.9	57.8	58.9	59.9	60.3	60.0	58.1	56.5	54.6	54.5	58.1
1883 ...	57.3	59.0	59.0	59.8	60.9	62.3	65.0	67.9	71.4	73.0	74.2	74.6	65.4
1884 ...	72.4	71.7	72.4	71.3	67.8	64.6	61.4	58.8	56.6	54.2	53.6	55.2	63.3
1885 ...	57.1	57.4	56.2	54.9	54.4	53.2	51.6	49.2	47.6	47.4	45.2	41.1	51.3
1886 ...	37.2	34.3	32.2	30.2	27.5	25.8	24.6	23.2	20.5	16.7	14.7	13.8	25.1
1887 ...	13.1	13.0	12.6	11.9	12.1	12.7	13.2	13.0	12.9	13.0	12.4	11.5	12.6
1888 ...	10.3	8.6	7.9	7.8	7.8	7.3	6.3	5.8	5.8	5.8	5.6	5.3	7.0
1889 ...	5.6	6.6	7.2	7.1	6.7	6.3	6.5	6.3	5.9	5.7	5.7	5.6	6.3
1890 ...	5.5	5.0	5.0	5.8	6.6	7.0	7.4	8.6	9.8	10.8	13.1	16.5	8.4
1891 ...	20.5	23.5	26.0	29.2	32.2	34.6	37.9	42.5	46.3	50.0	53.7	56.5	37.7
1892 ...	58.4	62.0	65.2	66.4	68.1	71.0	73.2	73.4	73.9	75.3	76.3	77.0	70.0
1893 ...	78.0	79.7	81.5	82.5	83.3	84.3	85.3	86.1	86.0	85.2	85.6	86.7	83.7
1894 ...	87.9	86.2	83.2	82.5	81.6	79.4	77.2	75.6	75.3	75.4	73.8	71.3	79.1
1895 ...	67.7	65.2	64.8	64.2	63.5	63.5	62.5	60.7	59.9	58.2	55.1	52.5	61.5
1896 ...	51.5	49.6	48.0	46.5	44.5	43.0	42.3	41.6	39.5	38.0	37.1	35.2	43.1
1897 ...	32.9	32.0	31.2	30.1	28.3	26.6	25.8	25.7	26.3	26.0	25.6	26.3	28.1
1898 ...	26.0	25.6	25.4	25.7	27.5	27.6	26.3	24.7	22.7	21.9	21.1	20.3	24.6
1899 ...	20.4	19.4	17.1	15.1	13.2	12.2	11.7	11.5	11.2	10.9	11.3	11.3	13.8
1900 ...	10.7	10.5	10.6	10.6	10.4	9.9	9.1	8.2	7.6	6.8	5.9	5.4	8.8
1901 ...	4.8	4.4	3.9	3.2	2.8	2.8	......	......	......	......	......	......	......

TABLE 3.—*Epochs of sun-spot maxima and minima.*

Minima.	Weight.	Maxima.	Weight.	Minima.	Weight.	Maxima.	Weight.
1610.8	5	1615.5	2	1755.2	9	1761.5	7
1619.0	1	1626.0	5	1766.5	5	1769.7	8
1634.0	2	1639.5	2	1775.5	7	1778.4	5
1645.0	5	1649.0	1	1784.7	4	1788.1	4
1655.0	1	1660.0	1	1798.3	9	1805.2	5
1666.0	2	1675.0	2	1810.6	8	1816.4	8
1679.5	2	1685.0	2	1823.3	10	1829.9	10
1689.5	2	1693.0	1	1833.9	10	1837.2	10
1698.0	1	1705.5	4	1843.5	10	1848.1	10
1712.0	3	1718.2	6	1856.0	10	1860.1	10
1723.5	2	1727.5	4	1867.2	10	1870.6	10
1734.0	2	1738.7	2	1878.9	10	1883.9	10
1745.0	2	1750.3	7	1889.6	10	1894.1	10

	Year.
Mean date of minima..	1744.21 $\pm$ 0.30
Mean date of maxima..	1749.37 $\pm$ 0.43
Length of the period from the minima....................................	$= 11.141 \pm 0.03_6$
Length of the period from the maxima....................................	$= 11.091 \pm 0.05_3$
Length of the period in general, or $\frac{1}{3}$ (max. + 2 min.)......................	$= 11.124 \pm 0.03_0$

TABLE 4.—*Mutual relations of maxima and minima.*

Date of—		Interval.		Ratio, $a : b$.	$r_{max.}$	Σr, min. to min.	Length of period, P, min. to min.	$r_{mean} = \frac{\Sigma r}{P}$.
Min.	Max.	Max. — min. = a.	Min. — max. = b.					
		Years.	*Years.*				*Years.*	
1745.0	1750.3	5.3	4.9	1.08	83	....	....	....
1755.2	1761.5	6.3	5.0	1.26	80	471.6	11.3	42
1766.5	1769.7	3.2	5.8	0.55	103	533.0	9.0	59
1775.5	1778.4	2.9	6.3	0.46	151	615.8	9.2	67
1784.7	1788.1	3.4	10.2	0.33	133	840.9	13.6	62
1798.3	1805.2	6.9	5.4	1.28	47	281.6	12.3	23
1810.6	1816.4	5.8	6.9	0.84	46	238.0	12.7	19
1823.3	1829.9	6.6	4.0	1.65	67	394.7	10.6	37
1833.9	1837.2	3.3	6.3	0.52	137	653.9	9.6	68
1843.5	1848.1	4.6	7.9	0.58	125	691.8	12.5	55
1856.0	1860.1	4.1	7.1	0.58	95	548.7	11.2	49
1867.2	1870.6	3.4	8.3	0.41	132	617.3	11.7	53
1878.9	1883.9	5.0	5.7	0.88	65	382.8	10.7	36
1889.6	1894.1	4.5	*7.4	*0.61	84	*458.8	*11.9	*39

*These figures depend on assumed values of the date and the r for the minimum of 1901.5.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

[For tables see page 204.]

Notes on the weather.—On the Pacific slope the weather was hot and sultry, with occasional showers but no proper beginning of the rainy season, although the average rainfall was generally above the normal. In San Jose the pressure was slightly below normal; the nights were hot and oppressive and the days rather cool and damp. The sunshine was much below normal (154 against 205 hours). On the Atlantic slope the rainfall was heavy and continuous, causing great damage to cacao growers.

Notes on earthquakes.—April 10, 11^h 8^m p. m., slight but strong shock, E-W, duration 7 seconds, intensity IV. April 13, 10^h 54^m p. m., prolonged tremors, ENE-WSW, duration 23 seconds, intensity IV. The severe earthquakes which were felt between April 18 and 22 in Guatemala, Honduras, and Salvador, the center of the disturbed region apparently being in the Altos of Guatemala, where Quezaltenango was almost entirely ruined, do not seem to have reached the southern part of Central America.

HAWAIIAN CLIMATOLOGICAL DATA.

By CURTIS J. LYONS, Territorial Meteorologist.

GENERAL SUMMARY FOR APRIL, 1902.

The water in artesian wells rose during the month from 34.05 to 34.10 feet above mean sea level. The average daily mean sea level for the month was 9.75 feet, 10.00 representing the assumed annual mean.

Trade wind days, 24 (8 of north-northeast); normal, 20; average force of wind (during daylight), Beaufort scale, 2.6; cloudiness, tenths of sky, 4.1; normal, tenths of sky, 5.1.

Approximate percentages of district rainfall as compared with normal: Hilo, 80; Hamakua, 100; Kohala, 120; Waimea,